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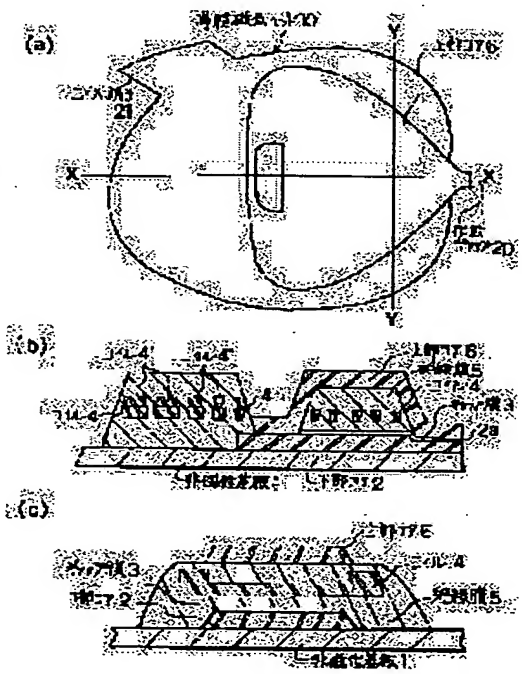
(54) THIN-FILM MAGNETIC HEAD AND ITS PRODUCTION

(57)Abstract:
PURPOSE: To provide the thin-film magnetic head which can decrease the coil resistance value without changing its window height even at a high TPI and a high speed transfer and the process for production of this magnetic head.
CONSTITUTION: The thin-film magnetic head is so constituted that the coils 4 and 4' at the rear end of the head have the thickness larger than the thickness of the thin-film coil 4 at the top of the head near a magnetic gap 20 covered with upper and lower cores 6 and 2. As a result, the step area of the coil is increased and the resistance value over the entire part of the coil is decreased without changing the window height of the magnetic gap, thereby the generation of thermal noises is suppressed.



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CLAIMS

[Claim(s)]
[Claim 1] The thin film magnetic head characterized by constituting thinly the thin film coil thickness for said point from thickness of a back end part in the thin film magnetic head which performs record playback of magnetic data by carrying out the magnetic gap configuration of the thin film coil for a point winding and near the magnetic-recording medium opposed face with the wrap upper part and a lower core, and energizing two or more thin film coils in said coil.
[Claim 2] The magnetic gap configuration of two or more thin film coils for a point winding and near the magnetic-recording medium opposed face is carried out for a vertical two-layer thin film coil with the wrap upper part and a lower core. The thin film magnetic head characterized by constituting more thinly than the thickness of a back end part the thickness of the vertical two-layer thin film coil for said point in the direction close to ** in the thin film magnetic head which performs record playback of magnetic data by energizing in said coil.
[Claim 3] The magnetic gap configuration of two or more thin film coils for a point winding and near the magnetic-recording medium opposed face is carried out for a vertical two-layer thin film coil with the wrap upper part and a lower core. It is the manufacture approach of the thin film magnetic head of performing record playback of magnetic data by energizing in said coil. The coil frame to which spacing becomes large at the head back end according to the other side is prepared on a nonmagnetic substrate. The manufacture approach of the thin film magnetic head characterized by constituting more thickly than the thickness for a point the thin film coil thickness of said back end part by fixing the 2nd additional thin film coil on said thin film coil of a head back end part after forming the 1st thin film coil in this coil inter-frame.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the thin film magnetic head which can reduce coil resistance, without starting the thin film magnetic head and its manufacture approach, especially changing aperture height, and its manufacture approach.
[0002]
[Description of the Prior Art] Generally, the thin film magnetic head prepares an up core for many thin film coils (it is only called a coil below) which minded [lower] the insulator layer on the non-magnetic-material substrate on the point part of winding and this wound coil, constitutes the magnetic gap between this upper part and a lower core, and performs record playback of magnetic data by energizing in said coil. Although this thin film magnetic head created the coil and could shorten the magnetic path by the thin film technology, it had the trouble referred to as that the coil cross-sectional area is small, and coil resistance becomes large, causes generating of thermal noise, and checks efficient data-logging playback in order to wind 1-10 micrometers and a very thin coil around a narrow field many times.
[0003] In order to solve this problem, the thin film magnetic head which constitutes more widely than the coil width of face near the gap the coil width of face of the periphery part of the head back end, and reduces resistance as indicated by JP,1-109507,A is proposed. This thin film magnetic head forms the lower core 2 in a part for the head point on the nonmagnetic substrate 1, as shown in drawing 5 . After covering the large coil 4 by winding and covering these by the insulator layer 5 many times as the width of face near the gap is besides narrow and the width of face of a back end part goes to a periphery, the coil 4 for a point is constituted so that a magnetic field may be generated with the up core 6 on a bonnet, the upper part, the lower core 6, and the gap film 3 between two. Especially this thin film magnetic head reduces resistance, without extending the aperture height corresponding to the width of recording track, in order to form broadly the width of face of the core 4 shown in the drawing 5 (a) left end as it goes to a periphery. In addition, the inside of drawing 5 and (a) are the direction sectional views of (Length Y) of the thin film magnetic head, and the direction sectional view of (Width X) of the thin film magnetic head and (b) are **. Moreover, the conventional thin film magnetic head is indicated by JP,55-84020,A etc.
[0004]
[Problem(s) to be Solved by the Invention] although the thin film magnetic head by the above-mentioned conventional technique decreases core resistance by [which go the core width of face of a periphery part to a periphery] it being alike, and following and supposing that it is broad, the width of recording track of a record medium became narrow by the demand of a raise in recording density in recent years, it was alike, and it followed and it had the nonconformity said that it is inadequate to fully decrease the thermal noise over regenerative-signal level to which regenerative-signal level falls only as the cure of said core width of face. That is, when regenerative-signal level fell by the demand of narrow track width of face, there was nonconformity said that the S/N ratio to regenerative-signal level is unmaintainable in the predetermined range.
[0005] The object of this invention is removing the nonconformity by said conventional technique, and is offering the thin film magnetic head which the resistance of a coil can be decreased [magnetic head] and can decrease generating of thermal noise further, and its manufacture approach.
[0006]
[Means for Solving the Problem] In order to attain said object, the thin film magnetic head by this invention is characterized [1st] by constituting more thinly than the thickness of a back end part the thin film coil thickness for the point inserted into the vertical core of the thin film magnetic head.
[0007] Moreover, the thin film magnetic head which wound two or more vertical two-layer thin film coils by this invention is characterized [2nd] by constituting more thinly than the thickness of a back end part the thickness of the vertical two-layer thin film coil for said point inserted into the vertical core of the thin film magnetic head in the direction close to **.
[0008] Furthermore, the manufacture approach of the thin film magnetic head by this invention The coil frame to which spacing becomes large at the head back end according to the other side is prepared on a nonmagnetic substrate. After forming the 1st thin film coil in this coil inter-frame, it is characterized [3rd] by constituting more thickly than the thickness for a point the thin film coil thickness of said back end part by fixing the 2nd additional thin film coil on said thin film coil of a head back end part.
[0009]

[Function] By having constituted more thinly than the thickness of a back end part the thin film coil thickness for the point inserted into the vertical core of the thin film magnetic head, and having extended the cross section of said back end part, the thin film magnetic head by said 1st description can decrease the resistance of a coil, and can decrease generating of thermal noise further.

[0010] By having constituted more thinly than the thickness of a back end part the thickness of the vertical two-layer thin film coil for said point inserted into the vertical core of the thin film magnetic head in the direction close to **, and having extended the cross section of said back end part, without making head height high, the thin film magnetic head by said 2nd description can decrease the resistance of a coil, and can decrease generating of thermal noise.

[0011] After the manufacture approach of the thin film magnetic head by said 3rd description forms the 1st thin film coil in this coil inter-frame, by fixing the 2nd additional thin film coil on said thin film coil of a head back end part, it can constitute more thickly than the thickness for a point the thin film coil thickness of said back end part, can decrease the resistance of a coil, and can decrease generating of thermal noise.

[0012]

[Example]

One example of the thin film magnetic head by below <explanation of thin film magnetic-head structure> this invention is explained with reference to a drawing. Drawing 1 is drawing showing the thin film magnetic head by the 1st example, and (a) is [the X-X cross-sectional view of (a) drawing and (c of a top view and (b))] Y-Y drawings of longitudinal section of (a) drawing. As the flat-surface appearance of the thin film magnetic head 10 by this example is shown in drawing (a), oblong elliptical is carried out, a right end has a record medium, the actuation gap 20 which approaches, and the end-winding child 21 whom the left end upper part connects with the exterior, and the coil 4 is wound around the interior. As shown in drawing (b) and (c), this thin film magnetic head 10 forms the lower core 2 and the gap film 3 in a part for the head point on the nonmagnetic substrate 1, prepares the coil 4 and 4' which were shielded by the insulator layer 5 on these, and it constitutes them so that the up core 6 corresponding to the lower core 2 for said point may be arranged further. It forms additional coil 4' further on the coil 4 of the back end while with an actuation gap of about 20 width of face is comparatively narrow and the width of face of the back end (drawing left) coil 4 makes the coil especially by this example broad at a periphery according to the other side. That is, in addition to making broad back end width of face of the coil 4 by the above-mentioned conventional technique at a periphery according to the other side, by fixing coil 4' further on the coil 4 of the back end, the coil of the thin film magnetic head by this example is constituted so that the coil cross section of a back end part may be extended further.

[0013] Therefore, without changing the aperture height of actuation gap 20 part, by extending the cross section of a back end partial coil on parenchyma, the thin film magnetic head constituted in this way can reduce resistance substantially, and can reduce thermal noise. In addition, in the case of a real component, up core 6 part in drawing 1 is still smaller, but in order that it may take coincidence with a sectional view and may make an understanding easy, it is expanded and illustrated in this Fig.

[0014] Drawing 2 (a) is drawing showing the Y-Y cross section of the thin film magnetic head by other examples, and the magnetic head by this example While adding coil 4' further and enlarging the cross section of a back end part on the coil 4 of the back end like said example It constitutes so that thickness (coil height) of the coil 4 for a point may be set to H2 thickly (highly) in H1 and the other range in the range almost equal to the range L1 (writing and read-out width of face) of the width of face which faces an actuation gap (refer to drawing 1 (a)). Although the head height of the part covered with up cores 6 other than range L1 of the width of face which faces the actuation gap of a coil 4 becomes high selectively at a concave, the thin film magnetic head by this example Since it does not become high in the width-of-recording-track processing part which forms the actuation gap 20, while effect can keep aperture height few to high-degree-of-accuracy processing of the width of recording track in the predetermined range By extending the back end and the coil cross section for a point, resistance can be reduced substantially and thermal noise can be reduced.

[0015] It is drawing showing the X-X cross section of the thin film magnetic head according [drawing 2 (b)] to other examples, and the magnetic head by this example forms additional coil 4' in a part for the center section of the up core 6 which met in the direction of X-X of the coil 4 for a point further, and decreases resistance further while it adds coil 4' further and enlarges the cross section of a back end part on the coil 4 of the back end like said example. Since the magnetic head by this example can roll a coil in accordance with the trapezoid slant-face configuration of an insulator layer 5, it can increase the number of winding of a coil (the number of turns) efficiently to the magnitude of the thin film magnetic head.

[0016] Drawing 2 (c) is drawing in which making the thin film magnetic head of said drawing 2 (a) example the so-called two-layer turn, and showing the Y-Y cross section of the thin film magnetic head. The thin film magnetic head by this example constitutes the thickness for a point of coils 41 and 42 (coil height) so that ** may be approached thinly, while a coil is made into the two-layer structure of the upper part coil 41 and the lower part coil 42, and each coils 41 and 42 add coil 4' further and enlarge the cross section of a back end part on the coil 4 of the back end like said example. If it puts in another way, it is thin so that the amount of [of the upper part coil 41] point may incline toward the lower core 2, and it constitutes thinly so that the amount of [of the lower part coil 42] point may incline toward the up core 6. Thus, since the constituted thin film magnetic head is arranged so that each cores 6 and 2 may be sunk into a part for the crevice from which each coil 41 and 42 constituted coil resistance thinly like said example in addition to the ability to decrease, it can increase a coil number of layers, without thickening the height

of the thin film magnetic head.
[0017] The thin film magnetic head by <explanation of the coil structure of the thin film magnetic head>, thus this invention is explained below with reference to drawing 3 about a suitable coil configuration to extend especially the cross section of a back end part on parenchyma, although resistance can be reduced substantially and thermal noise can be reduced by extending the cross section of a back end partial coil on parenchyma, without changing the aperture height of an actuation gap part.
[0018] Although the coil multistage [by this example] was illustrated to the drawing 1 (b) left, it is an enlarged drawing. A trapezoid with a base long after giving the plating substrate film 11 on the nonmagnetic substrate 1 Or the core frame 7 to which a base changes from a short trapezoid (it is only hereafter called a reverse trapezoid) insulating material to reverse is formed. (It is only hereafter called a trapezoid) It manufactures by forming the trapezoid or reverse trapezoid coil 4 between this frame 7, and forming on this trapezoid or reverse trapezoid additional coil 4' which reduces or is [amplification] similar with the downward coil 4.
[0019] If it states concretely, the downward coils 4 of what is shown in drawing 3 (a) will be a trapezoid configuration and the trapezoid configuration in which additional coil 4' carries out cutback parallelism with this coil 4. The downward coils 4 of what is shown in drawing 3 (b) are a trapezoid configuration and the trapezoid configuration in which additional coil 4' carries out amplification parallelism with this coil 4. The downward coils 4 of what is shown in drawing 3 (c) are a trapezoid configuration and the reverse trapezoid configuration in which additional coil 4' carries out cutback parallelism with this coil 4. What is shown in drawing 3 (d) is a reverse trapezoid configuration in which trapezoid configuration and additional coil 4' carries out [the downward coil 4] amplification parallelism with this coil 4, and these are the modifications of the trapezoid configuration where a base is [the downward coil 4] long.
[0020] Moreover, the downward coils 4 of what is shown in drawing 3 (e) are a reverse trapezoid configuration and the reverse trapezoid configuration in which additional coil 4' carries out cutback parallelism with this coil 4. The downward coils 4 of what is shown in drawing 3 (f) are a reverse trapezoid configuration and the reverse trapezoid configuration in which additional coil 4' carries out amplification parallelism with this coil. The downward coils 4 of what is shown in drawing 3 (g) are a reverse trapezoid configuration and the trapezoid configuration in which additional coil 4' carries out cutback parallelism with this coil 4. What is shown in drawing 3 (h) is a trapezoid configuration in which reverse trapezoid configuration and additional coil 4' carries out [the downward coil 4] amplification parallelism with this coil 4, and these are the modifications of the reverse trapezoid configuration where a base is [the downward coil 4] long. In addition, it can manufacture to this appearance from the difference in the inter-frame dimension of the coil frame which the coil frame trapezoid and reverse trapezoid in a coil which reproduced combination with the first coil frame variously reproduced with the combination of a negative mold or a positive type photoresist, respectively etc.
[0021] Thus, the coils which extend the cross section of the back end part of the thin film magnetic head by this example on parenchyma can decrease in number coil resistance by making the configuration of the downward coil 4 and additional coil 4' into trapezoid or reverse trapezoid combination.
[0022] <Explanation of coil manufacture approach> drawing 4 (a) thru/or (c) are drawings for explaining the manufacture approach of a suitable coil configuration to extend the cross section of the back end part of the thin film magnetic head on parenchyma like said 5th example, respectively.
[0023] After the manufacture approach first shown in drawing 4 (a) forms the coil frame 7 of longwise trapezoidal shape so that spacing may grow into the edge of the thin film magnetic head greatly according to the other side after giving the plating substrate film 11 on the nonmagnetic substrate 1, and it creates a downward coil 4 with electrolysis plating in this condition, where the part (the method of ****) covered with an up core later is covered by the photoresist 9, it creates additional coil 4' with electrolysis plating again. Then, the photoresistor 9, the coil frame 7, and the plating substrate film 11 of the aforementioned method of the Fig. right are removed, subsequently this part is covered with an insulator layer 5, and this thin film magnetic head is manufactured by adding the up core 6 further. According to this approach, the coil 4 of the reverse trapezoid configuration which becomes large [the cross section] at the head back end according to the other side, and 4' can be formed.
[0024] Moreover, after [said] giving the plating substrate film 11 on the nonmagnetic substrate 1 similarly, the manufacture approach shown in drawing 4 (b) forms the coil frame 7 of trapezoidal shape so that spacing may grow into the edge of the thin film magnetic head greatly according to the other side. After creating the downward coil 4 with electrolysis plating in this condition, where the part covered with an up core later is covered by the photoresist 9, additional frame 7' of trapezoidal shape is formed on the frame 7 of a head back end part. The additional coil 4 is fixed with electrolysis plating on this the additional frame 7' coil 4 of a between. According to this approach, the coil 4 of the reverse trapezoid configuration which becomes large [the cross section] at the head back end compared with said drawing 4 (a) example according to the other side, and 4' can be formed. In addition, in this production process, after forming the downward coil 4, the plating substrate film 11 may be removed, and additional coil 4' may be created for additional frame 7' after creation by using coil 4 ** as the plating substrate film.
[0025] Furthermore, after [said] giving the plating substrate film 11 on the nonmagnetic substrate 1 similarly, the manufacture approach shown in drawing 4 (c) forms the coil frame 7 of longwise trapezoidal shape so that spacing may grow into the back end of the thin film magnetic head greatly according to the other side, and after it creates the downward coil 4 with electrolysis plating in this condition, it gives the stopper film 8, such as nickel and Nip, by ion milling. This stopper film 8 is equivalent to the conductive film of different construction material from a coil. Subsequently, after preparing additional coil 4' with electrolysis plating again on this stopper film 8, it removes like a

graphic display of the upper bed part of the coil 4 for a head point at the condition of having covered the head back end part (drawing left) which is not covered with the up core 6 by the hot resist 9, by ion milling, and coil thickness is made thin. A photoresist 9, the coil frame 7, the substrate plating film 11, and the stopper film 8 are removed next, and the thin film magnetic head is constituted by forming the up core 6 at an insulator layer 5 and the head of head at these coils 4 and 4'. Thus, once the manufacture approach depended on this example forms two steps of coils 4, and 4' by making the stopper film 8 at the time of ion milling into an interlayer, it can create the thin film magnetic head which decreased coil resistance by removing additional coil 4' for a head point (part covered with the up core 6).

[0026] Thus, according to this example, the thin film magnetic head which has the coil of low resistance, without changing the aperture height of a magnetic gap part can be manufactured. For example, when it produces by this invention with the same magnitude as the present coil, and the number of turns, If it assumes that coil thickness is doubled [over the past] except the field (: three fourths of the head back end section and the whole abbreviation coils is occupied) which projected the configuration of a upside magnetic core on the flat surface, and the coil cross section doubles by this The general formula of resistance can be expressed with [a-one number], and resistance R' of the whole coil can specifically decrease to about 60% like [a-two number].

[0027]

[Equation 1]

R'=R (point rate + back end section rate x coil thickness rate of increase)

[0028]

[Equation 2]

R'=R(1/4+3/4x1/2) =5/8RR': Resistance of the whole coil by this invention R: If it is the resistance of the conventional whole coil, and the same resistance as the present coil, the rate which makes coil width of face large superficially toward the periphery from the inner circumference for the upper part and a lower core connection can be made small, and magnitude of the whole coil can be made small.

[0029]

[Effect of the Invention] As stated above, by having constituted more thinly than the thickness of a back end part the thin film coil thickness for the point inserted into the vertical core of the thin film magnetic head, and having extended the cross section of said back end part, the thin film magnetic head by this invention can decrease the resistance of a coil, and can decrease generating of thermal noise further. Moreover, after the manufacture approach by this invention forms the 1st thin film coil in the coil inter-frame to which spacing becomes large at the head back end according to the other side The thin film coil thickness of said back end part can be constituted more thickly than the thickness for a point by fixing an additional thin film coil on the thin film coil of a head back end part. By having extended the coil cross section of a back end part, the resistance of a coil can be decreased and generating of thermal noise can be decreased further.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing for explaining the thin film magnetic head by one example of this invention.
[Drawing 2] Drawing for explaining the thin film magnetic head by other examples of this invention.
[Drawing 3] Drawing for explaining the coil of the thin film magnetic head by this invention.
[Drawing 4] Drawing for explaining one example of the manufacture approach of the thin film magnetic head by this invention.
[Drawing 5] Drawing for explaining the thin film magnetic head by the conventional technique.
[Description of Notations]
1 [— A coil, 5 / — An insulator layer, 6 / — An up core, 7 / — A coil frame, 8 / — The conductive film, 9 / — A photoresist, 10 / — A thin film magnetic-head component, 11 / — Plating substrate film.] — A nonmagnetic substrate, 2 — A lower core, 3 — The gap film, 4

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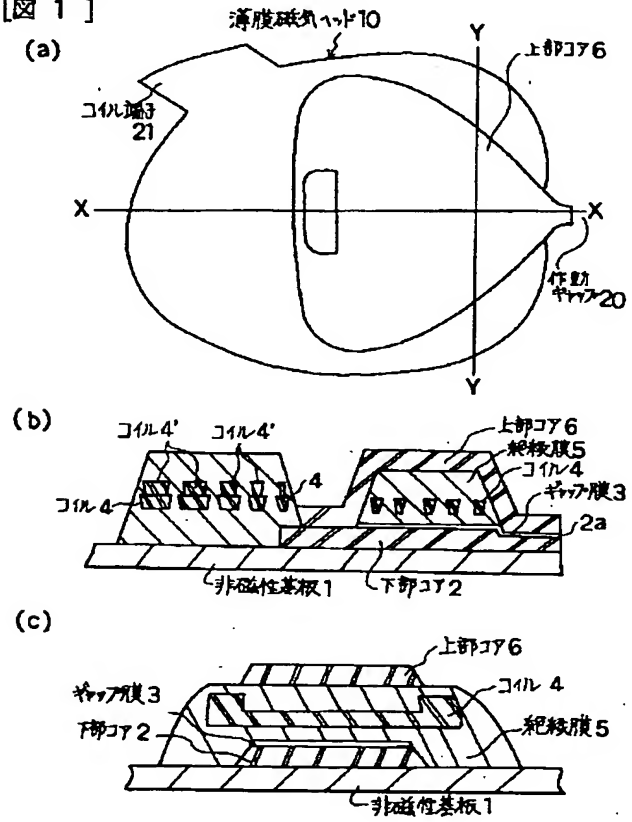
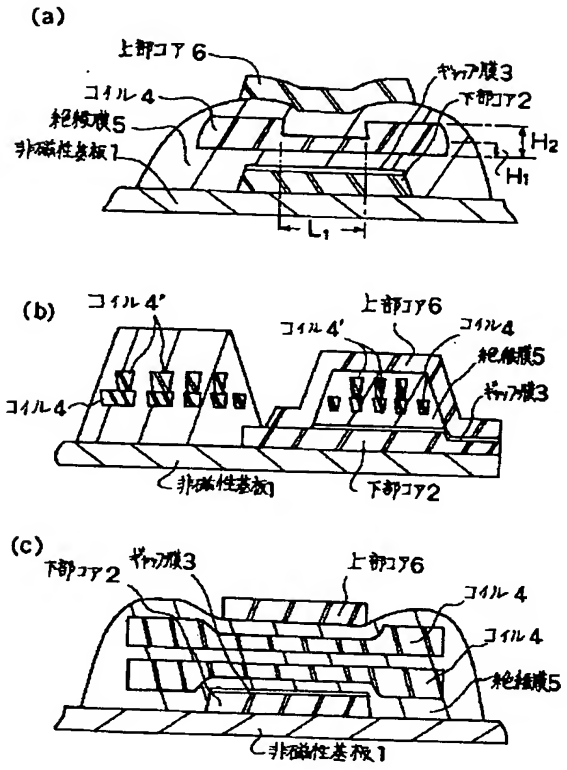
DRAWINGS

[Drawing 1]
[図 1]



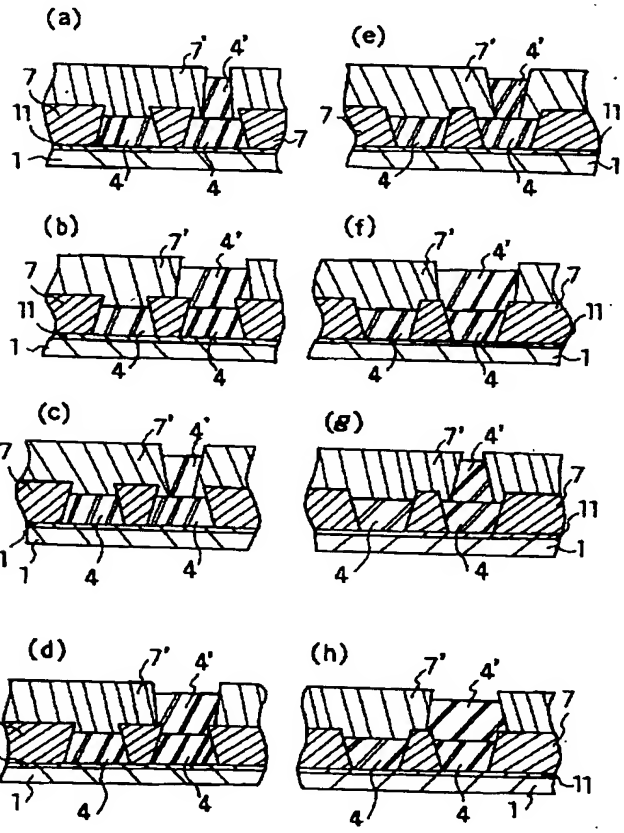
[Drawing 2]

[図 2]



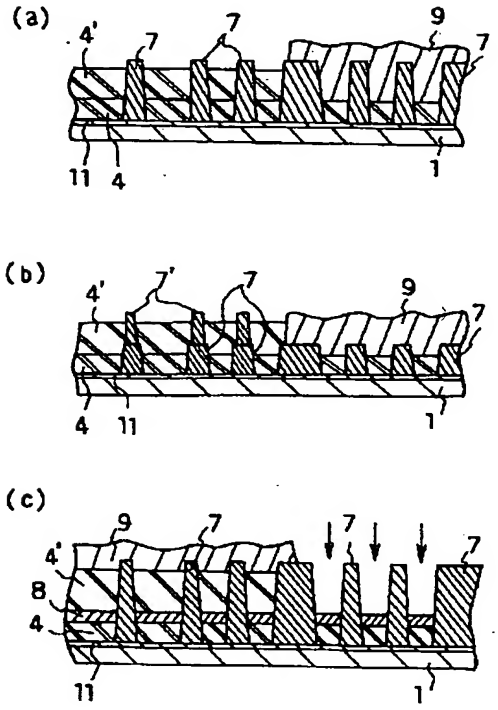
[Drawing 3]

[図 3]



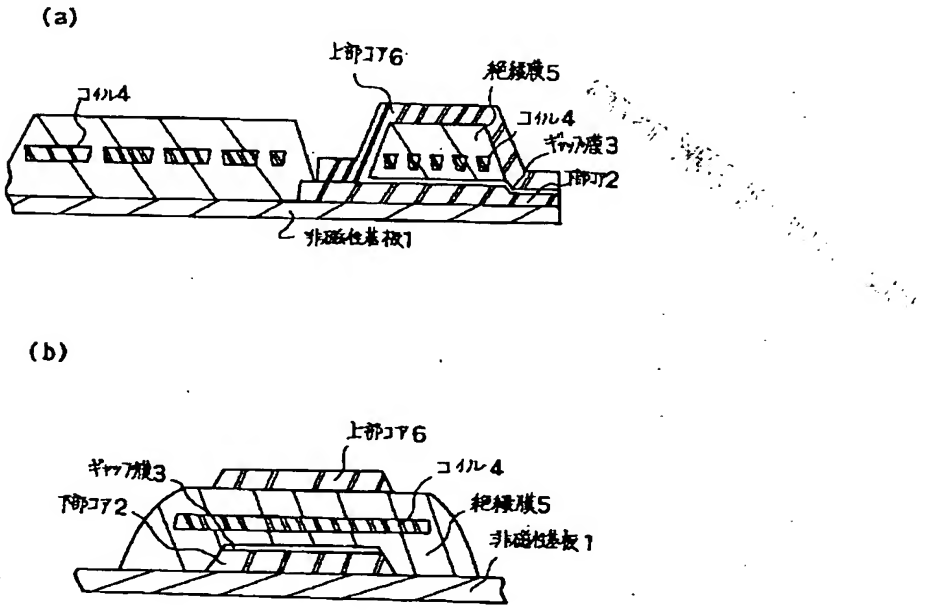
[Drawing 4]

[図 4]



[Drawing 5]

[図 5]



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